Bachelor Thesis FSS 2022

"Current topics in Service Operations Management"

Topic overview

Topic B01: Sharing Economy and its Implications for Operations Management

Sharing economy is a term used to describe a new form of business model established in the last decade. It describes online platforms matching a large number of buyers to a large number of small or private providers offering on-demand access to products and services. AirBnB, Uber, or Etsy are prominent examples for this business model. Due to its fundamental difference to established business models, some classical concepts or models from Operations Research and Management might not be applicable – at least not without adaptions.

The objectives of this thesis are to…
- introduce term and concept of sharing economy and contrast it to established business models;
- Present research questions and streams within operations management dealing with the sharing economy;
- Show and discuss examples of established OR models and approaches that need to be adapted to be applicable to the sharing economy.

Basic Literature:

Benjaafar, S., & Hu, M. (2020). Operations management in the age of the sharing economy: What is old and what is new?. *Manufacturing & Service Operations Management*, 22(1), 93-101.

Richter, C. et al. (2017). Digital entrepreneurship: Innovative business models for the sharing economy. *Creativity and Innovation Management*, 26(3), 300-310.

Rojanakit, P., de Oliveira, R. T., & Dulleck, U. (2022). The sharing economy: A critical review and research agenda. *Journal of Business Research*, 139, 1317-1334.

Topic B02: Emergence and Development of Behavioral Operations

Compared to other research fields, behavioral operations is a relatively new topic that emerged at the beginning of this century. Since then, the research field developed and matured, providing important insights for some of the most important problems companies are facing. It challenges the assumption underlying most research studies that customers are fully rational individuals and develops approaches on how to use realistic behavior in these studies. Regarding the context, the focus is not limited, thus ranging from manufacturing, to supply chain, to services. Behavioral operations is also not limited to a certain methodology, thus applying empirical surveys, experiments, mathematical modeling and other approaches.

The objectives of this thesis are to…
- introduce the term behavioral operations and position it within related research areas;
- present a summarized overview of its emergence and development in recent years;
- identify and discuss key research questions or streams within the field with a strong focus on services;
- provide open research gaps and future trends.

Basic Literature:

Croson, R. et al. (2013). Behavioral operations: the state of the field. *Journal of Operations Management*, 31(1-2), 1-5.

Donohue, K., Özer, Ö., & Zheng, Y. (2020). Behavioral operations: Past, present, and future. *Manufacturing & Service Operations Management*, 22(1), 191-202.

Victorino, L., et al. (2018). Service operations: what have we learned?. *Journal of Service Management*, 29 (1), 39-54.

Topic B03: Retrospective and Prospective Assessment of Service Operations Management

With the growing importance of services in the second half of the last century, the focus in research shifted, too. In operations management and research in specific, the scope was extended beyond manufacturing by analyzing service related research questions. Since then, a variety of topics and research areas within this field have developed, ranging from behavioral operations, to servitization, to service supply networks. After years of research, several researchers recently started reviewing what was achieved in this field over the last decades and what needs to change in terms of research focus or methods to deliver insights that are really needed today.

The objectives of this thesis are to…
- introduce the term service operations management and contrast it to related research fields;
- cluster the most relevant research questions from 2010 to today to identify key research areas;
- present an outlook on future focus areas of research in service operations management.

Basic Literature:

Field, J. M. et al. (2018). Service operations: what's next?. *Journal of Service Management*, 29 (1), 55-97.

Ostrom, A. L. et al. (2021). Service research priorities: managing and delivering service in turbulent times. *Journal of Service Research*, 24(3), 329-353.

Victorino, L., et al. (2018). Service operations: what have we learned?. *Journal of Service Management*, 29 (1), 39-54.

Topic B04: Identifying and Prioritizing Relevant Customer Journeys to Optimize Both Customer and Company Interests

Most companies provide a large number of services, each consisting of a variety of different customer journeys depending on context, customer segment or phase of the customer life cycle. If companies want to improve they face the challenge of selecting the right customer journeys to optimize – considering that there is neither enough time nor money to optimize everything. In addition, companies need to decide whether to focus on customer experience within these journeys, expecting higher profits from happier customers, or on sales, directly impacting financial results.

The objectives of this thesis are to…
- Define and interconnect the terms customer experience, customer journey, and touchpoint;
- Present empirical studies, optimization models, or theoretical models discussing either the link between individual customer journeys and overall customer experience / profits or approaches on how to find the right customer journey to optimize;
- Analyze to what degree different research fields like marketing, operations research or service research contribute to this research problem.

Basic Literature:

Lemon, K. N., & Verhoef, P. C. (2016). Understanding customer experience throughout the customer journey. *Journal of marketing*, 80(6), 69-96.

Zimmermann, R., & Auinger, A. (2022). Developing a conversion rate optimization framework for digital retailers—case study. **Journal of Marketing Analytics**, 1-11.

Zimmermann, R., Weitzl, W., & Auinger, A. (2022). Identifying Sales-Influencing Touchpoints along the Omnichannel Customer Journey. *Procedia Computer Science*, 196, 52-60.

Topic B05: Performance of product line design/selection problem under different choice models

Designing product lines is among the most critical strategic decisions of firms and industries in this competitive era. On the one hand, a firm's success and survival depend on customer satisfaction, and because of heterogeneous preferences and tastes, only by offering a sufficiently differentiated product portfolio, different customer needs can be satisfied. On the other hand, implementing or changing the product line could be too costly. The basic decision problem of product line design is to determine the products which should be offered and how to design them with regard to their price related and non-price related attributes such that product line profitability is maximized. In the scientific literature, the problem is known as product line design/selection and can be classified based on underlying assumptions, formulations, and solution methods. For example, different types of choice models (probabilistic vs. deterministic) are used in literature for this problem. Chen and Hausman (2000) analyzed the problem under a single-segment aggregated MNL model and showed that the problem can be solved efficiently. In the case of heterogeneous consumer preferences, the discrete finite mixture MNL (MMNL) model might be a better representative of consumer 'choice behavior. However, the resulting problem is not tractable and only under some assumptions (such as personalized pricing) efficiently solvable (Schön, 2010).

The objectives of this thesis are to…
- make a brief review of product line design/selection problem,
- show how problem formulations differ regarding the assumed customer choice behavior,
- implement the two alternative optimization problems under MNL (Chen and Hausman, 2000) and MMNL choice behavior (Schön, 2010), and discuss the structural properties (optional).

Basic Literature:

Belloni, A., Freund, R., Selove, M., & Simester, D. (2008). Optimizing product line designs: Efficient methods and comparisons. *Management Science, 54(9), 1544-1552.*

Chen, K. D., & Hausman, W. H. (2000). Mathematical properties of the optimal product line selection problem using choice-based conjoint analysis. *Management Science, 46(2), 327-332.*

Keane, M., & Wasi, N. (2013). Comparing alternative models of heterogeneity in consumer choice behavior. *Journal of Applied Econometrics, 28(6), 1018-1045.*

Schön, C. (2010). On the optimal product line selection problem with price discrimination. *Management Science, 56(5), 896-902.*

Topic B06: Structure of product line design/selection problem under different choice models

Decision problems from various fields (e.g., assortment optimization, product line selection, location planning) require incorporating probabilistic choice behavior in dependence of the availability of given choice alternatives. Attraction choice models are widely used in marketing and economics to model such choices and the multinomial logit model and in the case of multiple customer segments, the discrete finite mixture MNL (MMNL) are special cases of these models. However, integrating such models in optimization problems results in non-linear formulations. Bechler et.al (2021) made a review of several exact linearization approaches that have been proposed in recent years. In the case of product line selection, for instance, there are various models with different structures depending on the choice model used. Chen and Hausman (2000) analyzed the problem under a single-segment aggregated MNL model and showed that the non-linear problem can be solved efficiently. Schön (2010) extended the previous model for multiple segments by using the discrete finite mixture MNL (MMNL) and also linearized that under the assumption that each segment can be priced independently of the others.

The objectives of this thesis are to…
- make a brief review of product line design/selection problem,
- show how problem formulations differ regarding the assumed customer choice behavior,
- discuss in detail the linearization method used by Schön (2010), and
- implement an example instance of the two alternative optimization problems under the MMNL choice model for the original non-linear problem and the linearized version of that and compare the results. (optional)

Basic Literature:

Chen, K. D., & Hausman, W. H. (2000). Mathematical properties of the optimal product line selection problem using choice-based conjoint analysis. *Management Science, 46(2), 327-332.*

Schön, C. (2010). On the optimal product line selection problem with price discrimination. *Management Science, 56(5), 896-902.*

Bechler, G., Steinhardt, C., & Mackert, J. (2021). On the linear integration of attraction choice models in business optimization problems. *In Operations Research Forum (Vol. 2, No. 1, pp. 1-13). Springer International Publishing.*

Topic B07: Conventional discrete choice models and two-stage (consideration set-based) choice models

Choice models are widely used in different fields for capturing people's choice behavior. Random Utility Maximization (RUM) models are among the most famous ones. In RUM models, customers are assumed to be entirely rational and choose the product that maximizes their utility (Train 2009). Multinomial logit model, mixed multinomial logit model, etc. are among the RUM models. The limitations of RUMs, such as the requirement to satisfy the regularity rule and the independence of irrelevant attributes (IIA), have led to their inability to accurately model people's behavior and contextual effects. Two-stage or consideration set-based choice models have gained more attention because of their ability to overcome previously mentioned limitations. In these models, at the first stage, people construct a consideration set, which is a subset of the offered set, and it will be done based on people's partial rationality and lack of knowledge. In this step, the uncertainty about utilities is not resolved, and people use some heuristics to construct the consideration set. By assuming partial rationality, consideration-based choice models are removed from RUM models. Then, in the second step, individuals are regarded as rational and choose the most desirable alternative from the consideration set.

The objectives of this thesis are to…
- review and systematically summarize the literature on discrete choice models in category of RUMs and two-stage choice models,
- compare and discuss the benefits and drawbacks of each category of choice models regarding, the ability in modeling actual behavior, parameter estimation etc,
- provide open research gaps and future trends.

Basic Literature:
Train, K. E. (2009). "Discrete Choice Methods with Simulation", *Cambridge, Second Edition.* The book can be downloaded from http://eml.berkeley.edu/books/choice2.html

Hauser, J. R. (2014). Consideration-set heuristics. *Journal of Business Research, 67(8), 1688-1699.*

Wang, R. (2021). The Threshold Effects on Consumer Choice and Pricing Decisions. *Manufacturing & Service Operations Management.*

Ahumada, A., & Ülkü, L. (2018). Luce rule with limited consideration. *Mathematical Social Sciences, 93, 52-56.*

Echenique, F., & Saito, K. (2019). General luce model. *Economic Theory, 68(4), 811- 826.*

Topic B08: Review of Conjoint Analysis in Service Design with Focus on Banking Services

When designing a new service, the service providers can choose between different levels in various attributes of the service. For example, a bank can choose to offer a bank account either free of charge, for a transaction-based fees, or a monthly base fee. Any of these three price levels can be combined with different forms of customer support, like e.g. a customer hotline, an online support, or on-site consultation. Multiple combinations of attributes and their possible levels hence need to be considered and evaluated when designing a new service. For this purpose, Conjoint Analysis is a common method to determine the trade-off customers make when deciding between different purchase options. Thereby the part-worth values of different attribute levels are assessed. Insights into customer preferences allow both manufacturers and service providersto tailor their products and service offerings to the customer wishes in order to achieve a sufficient attraction on the customer side.

This thesis aims at reviewing the methodology and application of Conjoint Analysis in service operations management. The methodological approach should be described, and the current literature reviewed to provide an overview of the different application cases. Special attention should be paid to any applications in the banking industry.

The objectives of this thesis are to:

- conduct a literature review of existing works on service design and management in banking using Conjoint Analysis,
- provide a sound theoretical overview of the underlying methodological approach,
- and give recommendations for service design in face of the trade-off customers make in service operations.

Basic Literature:

Green, P. E., Krieger, A. M., & Wind, Y. (2001): Thirty years of conjoint analysis: Reflections and prospects. *INFORMS Journal on Applied Analytics,* 31(3_supplement), 56-73**.**

Danaher, P. J. (1997): Using conjoint analysis to determine the relative importance of service attributes measured in customer satisfaction surveys. *Journal of retailing*, 73(2), 235-260.

Dauda, S. Y., & Lee, J. (2015): Technology adoption: A conjoint analysis of consumers' preference on future online banking services. *Information Systems*, 53, 1-15.

Topic B09: Business Process Simulation of a Billing Process

Within the Business Process Management lifecycle, process optimization plays an important role to continuously monitor and improve the current processes. Yet, implementing process changes is often time and cost intensive. Thus, companies try to evaluate the potential benefits of different process design alternatives prior to doing any changes. Business process simulation (BPS) is a suitable tool for experimenting with the computer before changing the real process. Once the real process is closely enough resembled by the simulation model, scenario analysis helps to compare and evaluate different process design alternatives.

This thesis aims at building and analyzing a simulation model for the billing process of a real medium-sized consultancy, which wants to convert this internal process into a service offering to other companies. Before this new business opportunity is pursued, this specific process should be analyzed to address external customer needs. For this purpose, a simulation model should be built. The billing process usually starts with the receipt of all necessary data and ends with sending out the invoice. The longer the billing takes, the longer must the company generally wait to be paid. Hence, issuing invoices fast is an important financial goal. In collaboration with the consultancy, an interview should be scheduled to gather the necessary information to build the simulation model using Arena Simulation. After validation, different scenarios can be defined to determine optimization possibilities for achieving fast and customer-focused services.

The objectives of this thesis are to:

-   conduct a brief literature review of existing works about BPS and responsiveness in (financial) service processes,
-   provide a sound theoretical foundation of the simulation methodology and its applicability to this case,
-   and build and validate a simulation model of the current process.

Basic Literature:

Law, A. M. (2019): How to Build Valid and Credible Simulation Models. In *2019 Winter Simulation Conference (WSC)*, IEEE, 1402-1414

Santos Bernardes, E., & Hanna, M. D. (2009): A theoretical review of flexibility, agility and responsiveness in the operations management literature. *International Journal of Operations & Production Management,* 29(1), 30-53.

Madadi, N., Roudsari, A. H., Wong, K. Y., & Galankashi, M. R. (2013, September): Modeling and simulation of a bank queuing system. In *2013 Fifth International Conference on Computational Intelligence, Modelling and Simulation*, IEEE, 209-215.

Topic B10: Machine Learning in choice models – Are Artificial Neural Networks superior in forecasting demand?

The ability to predict consumer choice is beneficial for companies and governments before investing into any project. Consumer purchase decisions are dependent on different aspects of a product. A common assumption is that customers assign a utility to each product and choose the product which maximizes his utility. As the gained utility for each customer is different and is therefore difficult to observe, a random utility model is often applied. For that, the decision maker splits utility in an observable and unobservable part. By assigning different specifications about the unobserved portion of utility, different discrete choice models, like Multinominal Logit Model (MNL), Probit, Mixed Logit etc. are obtained.

In recent years, approaches from data science like neural nets have become popular and have been successfully applied in many diverse disciplines like biology, psychology, statistics, business, insurance, and computer science (West et al., 1997). These models emulate the basic structure of the human

brain by using multiple layers of connected perceptrons. It makes sense to model human choice behavior with human inspired algorithms to improve predictability. West et al. (1997) analyzed the performance of classical random utility models versus neural networks and found superior forecasting abilities for the later if the underlying relationship is unknow. Kaya et al. (2010) make an empirical comparison of Probit models and neural network approaches in modeling the brand choice decision in Turkish fast moving consumer goods sector.

The objectives of this thesis are to …
- review current discrete choice models under the random utility assumption,
- introduce the idea of using Artificial Neural Networks instead,
- compare different empirical studies on the performance of neural nets and models like MNL, Profit etc.,
- discuss the advantages and drawbacks using each approach and make a recommendation when to use which model,
- and give an outlook on future research opportunities in this field.

Basic Literature:

West, P. M., Brockett, P. L., & Golden, L. L. (1997). A comparative analysis of neural networks and statistical methods for predicting consumer choice. Marketing Science, 16(4), 370-391.

Kaya, T., Aktas, E., Topçu, İ., & Ülengin, B. (2010). Modeling toothpaste brand choice: an empirical comparison of artificial neural networks and multinomial probit model. International Journal of Computational Intelligence Systems, 3(5), 674-687.

Hruschka, H., Fettes, W., & Probst, M. (2004). An empirical comparison of the validity of a neural net based multinomial logit choice model to alternative model specifications. European Journal of Operational Research, 159(1), 166-180

Train, K., & Ebrary, Inc. (2009): Discrete choice methods with simulation (Second ed.). *Cambridge University Press*. New York Melbourne Madrid Cape Town Singapore São Paulo Delhi Mexico City

Topic B11: Conjoint analysis for choice of university for master studies

The reasoning for students for the choice of different business master programs can be diverse depending on how the program is positioned with regard to choice-determinant attributes. First, a university is in a city, which can be attractive by itself. Observable attributes like city size, average age or average living expenses can differ widely between cities. The part-worth utility of attributes like career service offerings, reputation/FT rank, WOM from master students, campus location, program types like general master's in management or with specialization, level of internationality and gap year offerings can be measured through direct interaction with former students. Universities are interested in the most important attributes for students, so that they can stay attractive in the upcoming years.

To get a better understanding of the value of each attribute a choice-based conjoint analysis (CBC) can be conducted. CBC is a decomposition method, which was developed in the 19th century and has become a widely used method in both worlds, commercial as well as scientific. It is a highly useful

method to derive part-worth utility for each attribute level. By conducting a choice experiment, former students are asked to select their most preferred university from a set of offered alternatives. Every university can be fictional and is defined by at least two attributes. The value of each attribute level can be derived using empirical techniques.

The objectives of this thesis are to:
- to review literature on empirical evidence for students' choice of university and the CBC approach,
- set up a CBC study for the choice of university for master students,
- conduct the CBC and analyze the study results,
- and give an outlook on future research opportunities in this field.

Basic Literature:

Baier, Daniel; Brusch, Michael (2009). Conjointanalyse: Methoden-Anwendungen-Praxisbeispiele: Springer-Verlag.

Eggers, F., Sattler, H., Teichert, T., & Völckner, F. (2018). Choice-Based Conjoint Analysis. Handbook of Market Research, Springer, Cham, 1-39.

Reutterer, T., & Dan, D. (2018). Cluster Analysis in Marketing Research. Handbook of Market Research, Springer, Cham, 1-29.

Erica Gralla, Jarrod Goentzel, Charles Fine (2013). Assessing Trade-offs among Multiple Objectives Humanitarian Aid for Delivery Using Expert Preferences, Production and operations management, https://doi.org/10.1111/poms.12110

Topic B12: Sequence effects in the design of experiential services

Past researchers have found empirical evidence that customers consider the sequence of event utility when evaluating past and future service experiences. Dixon and Verma (2013) provide a thorough review of the psychology and behavioral economics literature concerned with sequence effects and cite four main effects that emerge as relevant to sequencing service encounters: (i) the impact of the highest point, most intense, or highest utility part of an experience (Peak Effect); (ii) the impact of the last point of an experience (End Effect); (iii) the impact of the timing of the peak (Spread Effect); (iv) and the overall trend of the experience over time (Trend Effect).

Based on the empirical results Dixon & Thomson (2016) formulate an optimization problem with a focus on optimizing schedule sequence characteristics in order to maximize customer experiences. Other researchers (e.g., Das Gupta et al. 2016, Roels 2019) have developed mathematical models to optimize the service experience by incorporating selected psychological constructs like memory decay or acclimation and thereby mapping the underlying mental processes in the consumer's brain.

The objectives of this thesis are to:
- review and systematically classify current empirical knowledge on sequence effects as well as state-of-the-art optimization models incorporating sequence effects,

- compare different optimization approaches and discuss their advantages and limitations,
- discuss one optimization model in detail or compare two approaches,
- provide open research gaps and future trends and
- implement a subsection of the model in Dixon & Thomson (2016) in Excel (optional).

Basic Literature:

Bellos, I., & Kavadias, S. (2020). Service design for a holistic customer experience: A process framework. Management Science. Published Online: 21 Aug 2020 https://doi.org/10.1287/mnsc.2020.3609

Das Gupta, A., Karmarkar, U. S., & Roels, G. (2016). The design of experiential services with acclimation and memory decay: Optimal sequence and duration. Management Science, 62(5), 1278- 1296.

Dixon, M. J., & Thompson, G. M. (2016). Bundling and scheduling service packages with customer behavior: Model and heuristic. Production and Operations Management, 25(1), 36-55.

Topic B13: Empirical Evidence for network effects - How do product sales influence purchase behavior?

Consumer purchase decisions are dependent on different aspects of a product. First, there are attributes like color, size or price that are directly influenceable by the firm's decision maker. Other attributes like reputation, recommendations or network effect are much more difficult to influence or to measure. The network effect can be described as the impact that the number of customers using a network has on others' value from also joining the network. Usually, the value to the customer increases with an increase in product sales. This effect can take different forms and is mainly distinguished into global/local and direct/indirect network effect.

There is evidence, that customer take product sales in their decision making into account (e.g., the choice of messenger). Brynjolfsson and Kemerer (1996) showed over 25 years ago, that customers are more likely to purchase a spreadsheet product if the offering company has a higher market penetration. The paper outlines, that companies increase the price by 0.75% per one percent market share. Gallaugher et al. (2002) found similar results for the web server market.

Operations manager used this evidence to design models creating further implications. Cheng et al. (2012) showed that a free trial offer for some products may be beneficial for the overall company. On top of that, Wang (2021) showed, that it can be beneficial to sell products below its marginal costs to boost sales for other offered products.

The objectives of this thesis are to:
- to review the empirical literature analyzing the network effect,
- to review basic literature for implications from optimization models incorporating network effects,
- compare different empirical studies and discuss their limitations,
- discuss which aspects of empirical results are not considered in optimization models,
- and give an outlook on future research opportunities in this field.

Basic Literature:

Brynjolfsson, E., & Kemerer, C. F. (1996). Network Externalities in Microcomputer Software: An Econometric Analysis of the Spreadsheet Market. Management Science, 42(12), 1627–1647. https://doi.org/10.1287/mnsc.42.12.1627

Cheng, H. K., & Liu, Y. (2012). Optimal Software Free Trial Strategy: The Impact of Network Externalities and Consumer Uncertainty. Information Systems Research, 23(2), 488–504. https://doi.org/10.1287/isre.1110.0348

Gallaugher, J. M., & Wang, Y.-M. (2002). Understanding Network Effects in Software Markets: Evidence from Web Server Pricing. MIS Quarterly, 26(4), 303. https://doi.org/10.2307/4132311

Wang, R. (2020). On the assortment optimization with endogenized market size. Operations Research Letters, 48(5), 682–686. https://doi.org/10.1016/j.orl.2020.07.011

Topic B14: Optimal pricing for products with network effects

The price of the product is one of the most important attributes. This can be seen, as price optimization has a huge impact on increasing profits. According to a Harvard Business Review article, a price improvement of 1% leads on average to increased operating profit of 11,1% (based on 2453 companies and assuming no loss of volume). Products that are more valued from customers if sales of the product are high, encounter a network effect. This effect can take different forms and is mainly distinguished into global network effect and local network effect. Finding the optimal price is in particular difficult, as the sales of a product are dependent on the sales of the same product, which leads to an equilibrium condition.

Former scholars analyzed different aspects of product pricing. E.g., Cheng & Tang 2010 have shown that it could be beneficial to offer a product for free to boost the sales of a different product. Recent papers analyst problems with multiproduct pricing (Nosrat et al. (2021) and Qi et al. (2020)).

The objectives of this thesis are to:
- to review and systematically summarize the literature on product pricing with network effects,
- to highlight and explain one or two state-of-the-art pricing models with an example from practice,
- to provide open research gaps and future trends and
- to implement one pricing model with Excel (optional).

Basic Literature:

Cheng, H. K., & Tang, Q. C. (2010). Free trial or no free trial: Optimal software product design with network effects. *European Journal of Operational Research*, *205*(2), 437–447. https://doi.org/10.1016/j.ejor.2010.01.014

Nosrat, F., Cooper, W. L., & Wang, Z. (2021). Pricing for a product with network effects and mixed logit demand. Naval Research Logistics (NRL), 68(2), 159–182. https://doi.org/10.1002/nav.21943

Qi, W., Liu, X., Luo, X., & Zhang, Z.-L. (2020). Product Line Optimization Considering Network Effects. IEEE Systems Journal, 1–11. https://doi.org/10.1109/JSYST.2020.3035093

Topic B15: Scheduling models for eVTOL air taxi services

Electrical vertical takeoff and landing aircraft (eVTOL) are expected to enter service in this decade. Their operators will offer air taxi services powered by "green" electricity in order to provide a faster and more sustainable mode of transport in and between metropolitan areas as well as on the connected countryside. Similar to ride sharing services such as Uber, the service will work by order on demand. Differences to their ground-based counterparts are fixed landings stations called vertiports, limited charging & loading capabilities, as well as regulatory and operational rules. These specific requirements demand for new models for strategic decisions as well as new scheduling algorithms in daily operations.

The objectives of this thesis are to…
- introduce the eVTOL industry,
- summarize the literature of scheduling models of the industry,
- discuss and / or improve one model in detail (optional),
- provide open research gaps and future trends.

Basic Literature:

Fagerholt, K., Foss, B. A., & Horgen, O. J. (2009). A decision support model for establishing an air taxi service: a case study. *Journal of The Operational Research Society*, *60*(9), 1173-1182.

Rajendran, S., & Srinivas, S. (2020). Air taxi service for urban mobility: A critical review of recent developments, future challenges, and opportunities. *Transportation research part E: logistics and transportation review*, *143*, 102090.

Rajendran, S., & Zack, J. (2019). Insights on strategic air taxi network infrastructure locations using an iterative constrained clustering approach. *Transportation Research Part E: Logistics and Transportation Review*, *128*, 470-505.

Shao, Q., Shao, M., & Lu, Y. (2021). Terminal area control rules and eVTOL adaptive scheduling model for multi-vertiport system in urban air Mobility. *Transportation Research Part C: Emerging Technologies*, *132*, 103385.

Topic B16: Demand Models for the air taxi industry

Electrical vertical takeoff and landing aircraft (eVTOL) are expected to enter service in this decade. Their operators will offer air taxi services powered by "green" electricity in order to provide a faster and more sustainable mode of transport in and between metropolitan areas as well as on the connected countryside. Similar to ride sharing services such as Uber, the service will work by order on demand. Further competitors are the public transport, cars, or bikes. In order to make strategic decisions about pricing, vertiport locations, and operational principles, operators need to take customer preferences into account by using demand models. For this purpose, discrete choice models have been

used in many transport applications and also in urban travel to predict customer preferences and market shares.

The objectives of this thesis are to…
- introduce the eVTOL industry,
- summarize the literature of demand models of the eVTOL industry,
- discuss and / or improve one model in detail (optional, preferably a discrete choice model),
- provide open research gaps and future trends.

Basic Literature:

Boddupalli, S. S. (2019). *Estimating demand for an electric vertical landing and takeoff (eVTOL) air taxi service using discrete choice modeling* (Doctoral dissertation, Georgia Institute of Technology).

Garrow, L. A. (2016). *Discrete choice modelling and air travel demand: theory and applications*. Routledge.

Fu, M., Rothfeld, R., & Antoniou, C. (2019). Exploring preferences for transportation modes in an urban air mobility environment: Munich case study. *Transportation Research Record*, *2673*(10), 427-442.

Rajendran, S., & Srinivas, S. (2020). Air taxi service for urban mobility: A critical review of recent developments, future challenges, and opportunities. *Transportation research part E: logistics and transportation review*, *143*, 102090.

Topic B17: Safety Attributes for tourist accommodations during COVID 19

The choice between different accommodation options for a trip can be characterized as a discrete choice situation, as the best option is selected by customers. These decisions can be modelled with discrete choice models; their most prominent functional specification is the multinomial choice model (MNL). An underlying assumption of the models is the possible decomposition of the product or service into attributes with different levels, where each attribute level is connected to a particular partial utility. Datasets for choice estimation are created by choice tasks in which the preferred alternative has to be identified. Traditionally, these alternatives are represented by a specification of chosen attribute levels in text format.

In the past 15 years, there have been immense shocks for the traditional hotel industry. First, peer to peer accommodation sharing services such as Airbnb entered the market and took a significant market share from hotels. After the new competitors were established for a few years, the complete industry was hit hard by the breakout of COVID19. After a disastrous 2020, the demand rose again to make up for missed vacations but a change in customer preferences may be expected.

The objectives of this thesis are to…
- to briefly introduce the MNL and similar discrete choice models;
- to summarize the literature of conjoint studies in the field of tourist accommodation with a focus on the previously used attributes,
- discuss and / or improve one model in detail (optional),
- provide open research gaps and future trends.

Basic Literature:

Garrow, L. (2010). *Discrete choice modelling and air travel demand: Theory and applications.* Farnham, Surrey; Burlington, Vt.: Ashgate.

Kemperman, A. (2021). A review of research into discrete choice experiments in tourism: Launching the Annals of Tourism Research Curated Collection on Discrete Choice Experiments in Tourism. *Annals of Tourism Research*, *87*, 103-137.

Park, S., & Lehto, X. (2021). Understanding the opaque priority of safety measures and hotel customer choices after the COVID-19 pandemic: an application of discrete choice analysis. *Journal of Travel & Tourism Marketing*, *38*(7), 653-665.

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Topic B18: Demand models and preferences for public transport

Increased environmental conscientiousness as well as traffic jams are reasons for a required shift in the transport behavior of the urban population. The sharing economy with ride sharing services such as Uber or Drive Now and new transport modes such as e-scooters or air taxis open up the opportunity of redesigning the public transport landscape. In order to attract more customers to the public transport system or similar environmentally friendly transport modes, preferences of potential users have to be considered during network, service, and schedule design. A common tool to estimate these preferences are discrete choice models. They separate the overall utility of a trip into components, called attributes. Each attribute has several discrete levels or a continuous range of possible levels, and a combination of attribute levels represents a specification of a trip. These models have been used frequently to estimate customer preferences; especially in the field of transportation.

The objectives of this thesis are to…
- introduce discrete choice models and alternative demand models,
- summarize the literature of demand models of the public transport industry,
- discuss the use of demand models in optimization models for public transport,
- provide open research gaps and future trends.

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